

Drivers and Barriers in the Acceptance of Mobile Payment in China

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Abstract-China has the most mobile phone users in the world and mobile payment (MP) becomes a most promising area with the rapid increase in application of the mobile Internet. However, previous research on the reasons why the Chinese mobile phone users accept/adopt or are willing to use mobile payment has not come to a convincing conclusion. We propose a research model by integrating the prospective user's cost and perceived risk with Unified Theory of Acceptance and Use of Technology (UTAUT) and collect data by survey to investigate the determinants of the mobile payment acceptance in China. By revising the hypothesized model based on the data analysis by SPSS and AMOS, it is tested empirically that in the user's acceptance of mobile payment, performance expectancy and social influence are the drivers, whereas cost and perceived risks are the barriers. Theoretically, we extend the UTAUT model in the context of Chinese mobile payment acceptance. Practically, the findings of this study provide managerial insights to the mobile payment service providers and shed lights on the development of mobile payment in China.

Keywords-mobile payment (MP); Unified Theory of Acceptance and Use of Technology (UTAUT) ; consumer acceptance; Structural Equation Modeling

I. INTRODUCTION

Mobile payment (MP) refers to making payments using mobile devices such as mobile phones, personal digital assistants (PDA), radio frequency (RF) devices or near-field communication (NFC) based devices [1]. MP is a promising area and the largest potential market is China. It is reported that by June, 2010, among 800 million mobile phone users in China, 277 million users had explored the Internet with their mobile phones and 6.1% of them had experienced MP [2]. The transaction volume of MP was ¥790 million in 2008 and increased to ¥2400 million in 2009 [3] due to the application of 3G mobile communication technology.

To explore the key determinants that drive or hinder the development of MP, our research examines the positive and negative factors which determine consumer acceptance of MP using mobile phones. We review the prior literature and propose a research model by expanding the UTAUT model. Subsequently, using survey data from Chinese respondents, we test our hypotheses in the model and modify the model according to the indices in SPSS and AMOS. Finally, we conclude our findings and provide implications for managerial practice. Identifying the drivers and barriers in the acceptance of MP in the context of China will make important theoretical and practical contributions to this field.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The research on MP has two streams. One is on the mobile technology in constant evolution, e.g., the MP system [1, 4]; the other is on the consumer acceptance/adoption of the technology with various empirical models based on Technology Acceptance Model (TAM) [5-9] or UTAUT model [10-13]. Although many empirical researches have been done in the same domain (MP, mobile banking and mobile commerce), different researchers come to different antecedents of the acceptance of MP. In the recent review on MP research by Dahlberg et al.[14], the most used constructs to study consumer acceptance are, respectively, ease of use, usefulness, cost, trust, compatibility, social influence, risk, security and convenience. Because the constructs of ease of use, usefulness, compatibility, social influence and convenience have been integrated by Venkatesh et al. into the robust UTAUT model [15], and trust and security were the other side of risk, we adopt UTAUT model as the driving factors and cost and perceived risk as the barriers in the acceptance of MP.

We are surprised to find that in China, the largest potential MP market in the world, a same factor may be validated in different papers to have a positive, negative or insignificant effect on MP acceptance. For example, perceived risk is always hypothesized to have a negative influence on behavioral intention [16] but it has been verified empirically to be positive in several Chinese studies [17-20]. The effect of usefulness on behavioral intention even can be not significant at $P<0.05$ level [17]. Effort expectancy, is always hypothesized or supported to be a key factor to affect the consumer acceptance of MP (e.g., by Min, Ji & Qu [13] and Park, Yang & Lehto [12]) but is not supported with survey data by Zhou, Lu & Wang [10] and Chen & Tang [18, 19]. Facilitating conditions, another key construct in UTAUT, is supported Zhou, Lu & Wang [10] and Cao & Li [21], but refused by Park, Yang & Lehto [12] and Chen & Tang[18, 19]. Cost is also hypothesized to be a negative factor and supported by Cao & Li [21], but refused by Chen & Tang [18, 19]. What on earth are the factors that drive or inhibit the consumers to use MP in China? Our research attempts to examine this issue.

A. The UTAUT Model

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was proposed by Venkatesh et al. in 2003 [15]. UTAUT integrates eight extant models and consists of four determinants which are performance expectancy, efforts

expectancy, social influence and facilitation conditions. Performance expectancy (PE) is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance". Effort expectancy (EE) is "the degree of ease associated with the use of the system". Social influence (SI) refers to "the degree to which an individual perceives that important others believe he or she should use the new system". Facilitating condition (FC) is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system". In addition, the four determinants are moderated by gender, age, experience and voluntariness of use (see Fig. 1). The UTAUT model is frequently adopted not only in the MP acceptance research as mentioned above, but also in the adoption and use of other information systems such as e-commerce[22], online stocking[23], blog[24], course management software[25], and so on.

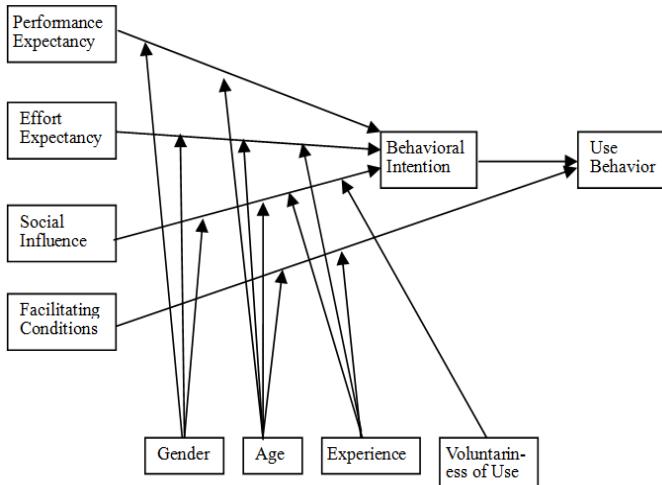


Fig. 1 The UTAUT model [15]

Our research focuses on the key determinants of MP acceptance so we put the moderators aside. Per se, voluntariness of use exerts no moderating effect in individualized acceptance, age and experience are similar for the limitation of our sample, and the moderating effects of gender are proved insignificant in post hoc analysis. Therefore, based on UTAUT, we hypothesize:

H1: Performance expectancy positively affects behavioral intention of MP.

H2: Effort expectancy positively affects behavioral intention of MP.

H3: Social influence positively affects behavioral intention of MP.

H4: Facilitating conditions positively affect actual use of MP.

H5: Behavioral intention positively affects actual use of MP.

B. Perceived Risk and Cost

The concept of "risk" in economics can be traced back to the 1920s and the construct of "perceived risk" (PR) in marketing literature is universally acknowledged to be introduced by Bauer in 1960 [26]. Perceived risk refers to the extent to which the prospective user expects MP to be risky.

Pavlou [27] identifies perceived risk as a direct antecedent of consumers' intention to accept online transaction. Mallat [28] collects data by interviews in six focus group sessions and finds in his explorative study that perceived security risk is a vital determinant for MP acceptance which has 6 contributing factors, namely, unauthorized use, transaction errors, lack of transaction record and documentation, vague transactions, concerns on device and network reliability and concerns on privacy. It is also substantiated by Chen [5] and Wu & Wang [9] that in Taiwan market perceived risk is a critical factor in MP or mobile commerce acceptance. With reference to the investigation by iResearch Company [3], 48% of the cellular users who refuse to use MP are due to security concerns. Given the infancy of the market and the uncertainty of the MP environment, perceived risk is a key barrier to MP acceptance, therefore we propose:

H6: Perceived risk negatively affects behavioral intention of MP.

Cost or perceived cost refers to the extent to which a person believes that using mobile payment will cost money. Cost is considered as another important inhibitor affecting user's behavioral intention in MP [14, 28] and in similar domains such as mobile commerce [9], mobile banking [29], 3G mobile value-added services [30], 3G phones [31], and so on. When a consumer intends to accept MP, she/he will conduct a cost–benefit evaluation before making a decision. By contrast with traditional payment, costs of MP involve direct transaction fee, access cost of usage (i.e., SMS/WAP/3G expense) and equipment cost (e.g., a new mobile phone). Thus we hypothesize:

H7: Cost negatively affects behavioral intention of MP.

C. The Research Model

As the hypotheses proposed above, performance expectancy, efforts expectancy, social influence and facilitation conditions based on UTAUT are the drivers while perceived risk and cost are the barriers in the MP acceptance. The research model of this paper is presented as Fig. 2.

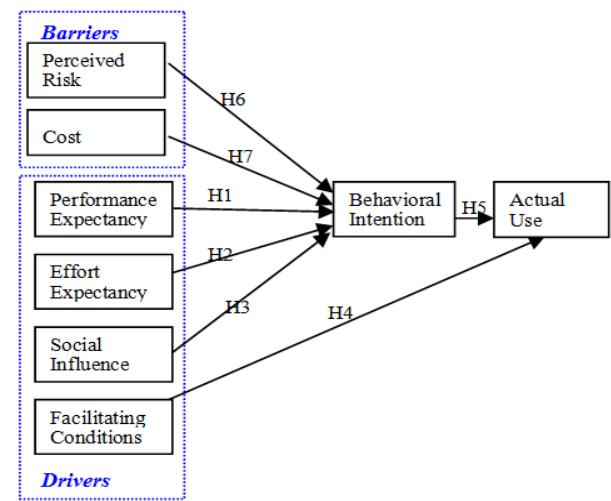


Fig. 2 The research model

III. DATA COLLECTION AND ANALYSIS

A. Questionnaire Design

Our research model comprises eight constructs, six of which are adopted from UTAUT and the other two are well discussed in existing literature, so all of our measuring items are adapted from prior study and modified to fit the context of

MP. The main measurements (see Table I) were designed according to the existing literature and measured with a five point Likert scale with answer choices range from “strongly disagree” to “strongly agree”. Demographic data such as gender, age, experience of using MP and understanding level of MP were also collected in the questionnaire.

TABLE I CONSTRUCTS AND MEASUREMENTS

Construct	Item	Measurement	Reference
Perceived Risk	R1* R2* R3* R4	I am afraid for faultiness in the function of MP. I am afraid for exposure of privacy if using MP. I am afraid for unreasonable or fraudulent charges if using MP. I am afraid for waste of time when using MP.	[5, 9, 14, 27, 28]
Cost	C1 C2* C3* C4*	I think my cellular cannot make MP and it's expensive for a new one. I think the access cost is expensive of using MP. I think the cost is very high to access the MP system. I think the transaction fee is expensive of using MP.	[9, 14, 28-31]
Performance Expectancy	PE1* PE2* PE3* PE4 PE5	I think MP is useful for me to buy products or services. I think MP makes it easier for me to buy products or services. I think MP saves time for me to buy products or services. I think MP is more prompt than other payment patterns. I think MP can make things better than other payment patterns.	[14, 15, 22-25]
Effort Expectancy	EE1 EE2 EE3 EE4	I think using MP is easy. I think it is easy for me to learn how to use MP. I think the use's interface of MP is friendly. I don't think it will spend much time in learning to use MP.	[14, 15, 22-25]
Social Influence	SI1 SI2 SI3* SI4 SI5 SI6*	My relatives or my friends also use MP. People important to me think I should use MP. The recommendation of MP by my friends will affect my decision. Using MP I can communicate with some specific group better. I can't keep in tune with others if they use MP while I don't. I am expected or needed to use MP in my study/work.	[14, 15, 22-25]
Facilitating Conditions	FC1 FC2 FC3 FC4 FC5	I think it is easy to buy a cellular for MP. I think the MP system is accessible if necessary for me. I think it is easy for me to find the knowledge of MP. It's easy for me to use MP though I have never experienced it before. If I have difficulty in using MP, I can find friends to help me.	[14, 15, 22-25]
Behavioral Intention	BI1 BI2 BI3* BI4*	I am willing to learn how to use mobile payment. I will try to use mobile payment if necessary. I intend to use mobile payment often. I am willing to recommend mobile payment to my friends.	[14, 15, 22-25]
Actual Use	B1* B2*	I often use cellular mobile payments. I have ever recommended mobile payment service to others.	[14, 15, 22-25]

Note: * indicates the item is retained and supported in the final data analysis.

B. Data Collection

The survey respondents participated in this study are junior and senior students in a provincial university. Since they all have mobile phones, college students are reported to be the main user groups of mobile phone and mobile networks [2, 3], and most of them were having a job experience in business for several weeks to several months according to the training plan, the respondents are typical and representative of the population studied. Some respondents were asked to answer the questionnaires in the class meeting in front of the investigators, the others who were not at school got the questionnaires from QQ group of their class and answered via emails. The investigation lasted from March to July in 2010. The response rate is optimistic for the students finished the work actively at the teachers' request. 195 questionnaires were

returned, among which a total of 186 responses were complete and involved in the statistical analysis, with a 93% valid return rate. The valid samples include 85 male and 101 female students aged 20 to 23. 60% of them have a 2 to 4 year experience of mobile phone and understand the usage of mobile phone quite well, while 65% of them don't know much about MP, which is an evidence of the infancy of the MP market.

C. Data Analysis

In the data analysis process, we employed two powerful statistical programs, SPSS16.0 and AMOS17.0 by SPSS Inc., both of which allowed the researchers to iteratively modify the proposed model to improve the reliability, validity and model fit in the directions of the statistica 1 indices together with the

theoretical meaning simultaneously. Data speak louder than words. We analyzed the construct reliability if item deleted and the model validity with an Exploratory Factor Analysis (EFA) approach in SPSS, then 10 items were dropped. Subsequently, the data of the rest items were input to AMOS. Using the Structural Equation Modeling (SEM) technique, AMOS put out the estimates of the model, modification

indices and model fit (see Fig. 3). The indicators suggested the modification for a better model fit and validation of the final model. During the modification, two constructs and some items were dropped and a causal path was revised (see Fig. 4). The specific model processing and modification processes and approaches with reasons and results are listed in Table II.

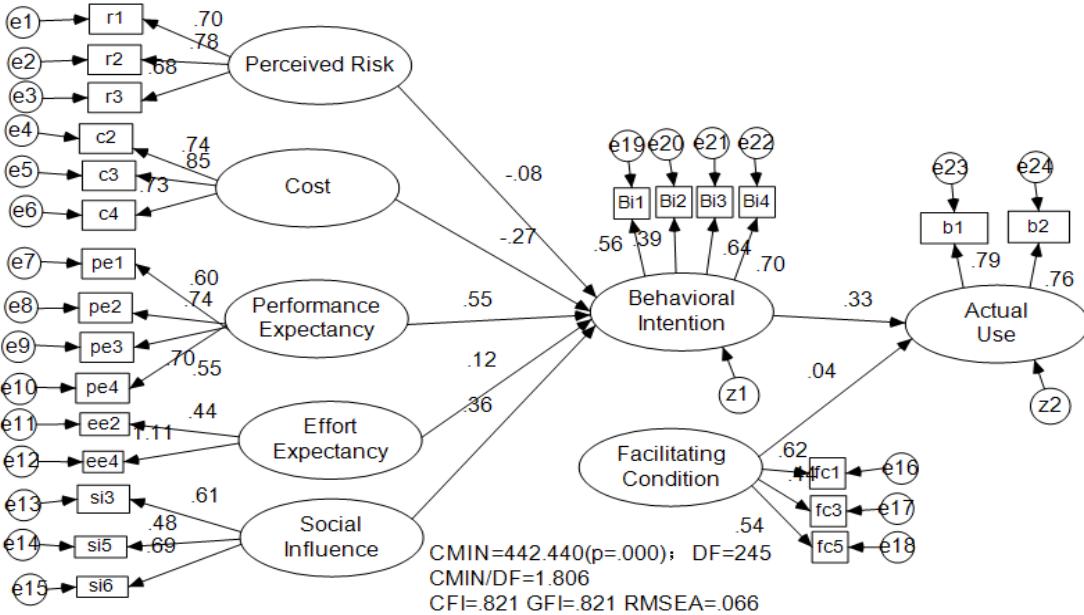


Fig. 3 Initial estimates and model fit indicators in AMOS

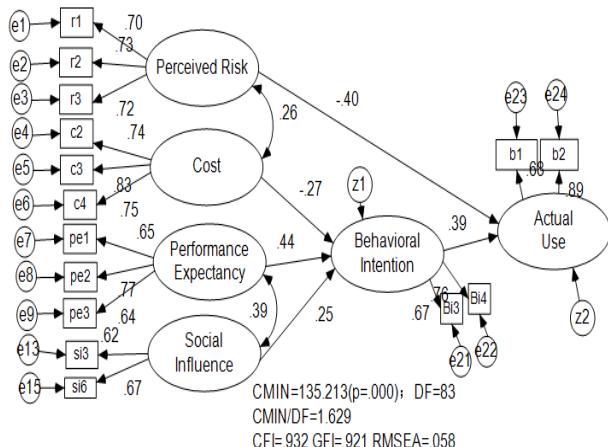
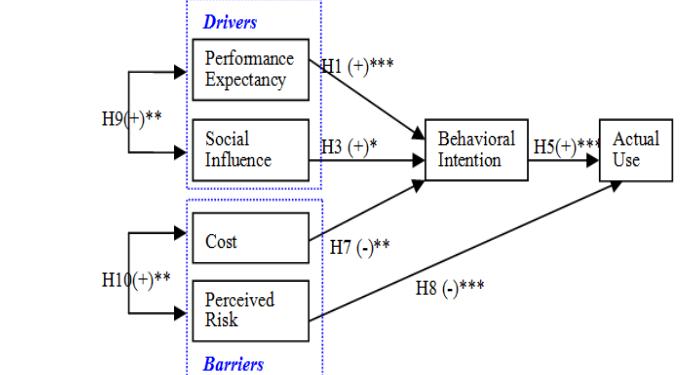


Fig.4 Final estimates and model fit indicators in AMOS

IV. CONCLUSION AND DISCUSSION

Our study suggests that (see Fig. 5) consumer acceptance of MP is driven by performance expectancy and social influence whereas obstructed by perceived risk and cost simultaneously. The results of this study have a number of important implications in both theory and practice. In theory, UTAUT is tested to need be expanded or revised in the



Note: (+) positive effect, (-) negative effect;
*** P< .001, ** P< .01, * P< .05

Fig. 5 The empirical results of the study

context of the specific area of technology acceptance. As to conditions are not. Perceived risk and cost have negative effect on consumer adoption, but perceived risk affects actual use without the mediating effect of behavioral intention. Moreover, performance expectancy and social influence, and perceived risk and cost are proved to be correlated respectively. This study provides a reasonable explanation and

Process & approach (1): Construct reliability (Cronbach's Alpha) if item deleted in SPSS Statistical result & suggestion: The construct reliability of social influence is .644 but it will increase to .657 if item SI1 is deleted. The construct reliability of perceived risk is .651 but it will increase to .760 if item R4 is deleted. The construct reliability of cost is .710 but it will increase to .815 if item C1 is deleted. The construct reliability will decrease if some other item is deleted. Model processing: The items of SI1, R4 and C1 were dropped. Theoretical explanations & implications: After dropping the three items, the reliability (Cronbach's Alpha) of the whole constructs climbs up to .804, which is at a acceptable level for the threshold of Cronbach's Alpha is .70. It indicates that items SI1, R4 and C1 cannot measure the construct right respectively. The practical explanation is that the respondents think whether their relatives and friends use MP have nothing to do with their MP acceptance. Similarly, time consuming and extra cost for a new cellular cannot be attributed to MP acceptance.
Process & approach (2): EFA in SPSS Statistical result & suggestion: The KMO is .766 and the Bartlett's test of sphericity is significant at a P=.000 level, so the model is suitable for the factorial analysis. Extracted by Principal Component Analysis and rotated by Varimax with Kaiser Normalization, the factor loadings on the constructs are above .50 except PE5, EE1, EE3, FC2, FC4, SI2 and SI4. This means a good convergent and discriminant validity except for the seven items. Model processing: The items of PE5, EE1, EE3, FC2, FC4, SI2 and SI4 were dropped. Theoretical explanations & implications: PE5, EE1, EE3, FC2, FC4, SI2 and SI4 can't measure the construct, probably for the misleading wording and misunderstanding of the items. Fortunately, no less than two items were left for each construct so that each construct could be measured exactly after these items were dropped.
Process & approach (3): Calculating estimates, modification indices and model fit in AMOS Statistical result & suggestion: The recommended criteria for model fit is chi-square/degrees of freedom (CMIN/DF)>3, CFI>.90, GFI>.90 and RMSEA<.08 [32]. As showed in Fig. 3, the CFI and GFI are not very good. In the same time, the p-values of perceived risk to behavioral intention, effort expectancy to behavioral intention and facilitating conditions to actual use are much larger than .05 and their path coefficients are very small accordingly. The modification index of a new path from perceived risk to actual use is as large as 17.35. Model processing: The causal path of perceived risk to behavioral intention was removed to actual use (see Fig. 4). Hence, another hypothesis is proposed: H8: Perceived risk negatively affects actual use of MP. Theoretical explanations & implications: Perceived risk doesn't affect behavioral intention but affects actual use of MP directly. After the removal of the path, the model fit indicators got closer to the assessment criteria.
Process & approach (4): Further revision of the model based on indicators in AMOS Statistical result & suggestion: The p-values of effort expectancy to behavioral intention and facilitating conditions to actual use are still much larger than .05 and their path coefficients are very small accordingly. Model processing: These two paths were cut off one by one (see Fig. 4). Theoretical explanations & implications: H2 and H4 are not supported by the survey data, which means that effort expectancy and facilitating conditions are not the driving factors in MP acceptance. Other evidence to prove the result lies in that effort expectancy has been verified to be irrelative to the MP acceptance in Chinese market in several studies [10]. Neither was facilitating conditions [12]. After this revision, the model becomes parsimonious and the model fits much better than before.
Process & approach (5): Interrelationship between the independent variables in AMOS Statistical result & suggestion: The modification indices indicated that if we treat the covariance between performance expectancy and social influence as a free parameter, the discrepancy would fall by at least 10.854, and would fall by at least 6.881 if perceived risk and cost were correlated. Model processing: A double arrow arc was drawn between performance expectancy and social influence, and another one was between perceived risk and cost (see Figure 4). At the same time, two more hypotheses were added: H9: Performance expectancy correlates with social influence positively. H10: Perceived risk correlates with cost positively. Theoretical explanations & implications: More performance expectancy, more social influence. For a new IT service, both the perceived risk and cost are relatively high.
Process & approach (6): Item refining in AMOS Statistical result & suggestion: Some of the factor loadings were still less than .60. Model processing: BI2, SI5, PE4 and BI1 were dropped. Theoretical explanations & implications: The model was refined. All the indicators went to a satisfactory level as presented in Fig. 4. The modified model indicates an excellent fit to the data.

TABLE II . DATA PROCESSING AND THE REASONABLE EXPLANATIONS

a better understanding to the different results in MP acceptance.
For practitioners engaged in MP such as cellular manufacturers, mobile communication companies, commercial banks and merchants where MP are available, understanding the drivers and barriers in the MP acceptance in China is crucial in the design and development of devices and services. Especially, our study provides interesting insights into the development of

MP in the largest market for the MP stakeholders. For one thing, the drivers, performance expectancy and social influence, should be promoted. Don't waste time in advertising on the ease of use MP. The operation process of MP on the cellular is not a problem for the consumers. They care most about benefits in the application of MP. The publicity should focus on the convenience in various specific scenarios. Word-of-mouth advertising and free of charge promotion should also be addressed for the actual users will influence on many prospective customers. For another, the barriers, perceived risk and cost, should be decreased to enlarge the market share. Information on the actual risk and actual cost must be presented in details and clear to lower down the "perceived" risk and cost. The actual cost of MP can be reduced not only from the service provider's perspective but also from the user's perspective by multiple customized tariffs. When the actual cost can't be cut down for the sake of economic goals, the decrease of perceived risk will make the cost more acceptable. Reputation, satisfaction with past transaction and frequency are antecedents of risks [27], so the MP service providers should pay much attention on their brand images and customer satisfaction.

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